

THE CRITICAL PERIOD OF WHEAT AT COLLEGE PARK, MD.<sup>1</sup>

By W. J. SANDO.

[Author's abstract.]

In the fall of 1920 a careful study was initiated for the purpose of ascertaining the relation of climate to the yield of wheat grown on the Maryland Agricultural Experiment Station farm at College Park. Four varieties of wheat were used in making the study. The yield records cover a period of 12 years.

Correlation coefficients for temperature and precipitation for each month of the growing period and for each variety were determined. A significant negative correlation was found between precipitation and yield for March and May. No significant correlation could be found between temperature and yield.

Other factors were also investigated, but further study will be necessary before their actual relation to yield are determined.

## DISCUSSION.

In the discussion of Mr. Sando's paper it was stated by C. F. Brooks that a tabulation of wheat yields and corresponding rainfall in different parts of the United States showed that the best yields were obtained with about 30 inches of annual rainfall, and that the yields where the rainfall was over 50 inches were about as poor as in the regions where the rainfall was less than 15 or 10 inches a year. College Park, Md., being in a region with an average rainfall of about 50 inches a year, would thus have better yields when the rainfall was less than the average, while a place in the semiarid West would have better yields when the rainfall was more than the average. Even though, theoretically, plentiful rainfall between the time of heading and time of harvest should be beneficial, the damage done by smuts and rusts in the warm moist weather of eastern Maryland seems to be responsible for the greatly reduced yields when there is much rainfall in this period.

<sup>1</sup> Presented before American Meteorological Society, Apr. 20, 1921.

## INDICATOR PRECIPITATION-STATIONS FOR PREDICTING STREAM DISCHARGE.

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By H. L. STONER.

[Abstracted by J. Cecil Alter from an office report, dated January, 1921.]

## SYNOPSIS.

Three precipitation stations, widely separated and manned by cooperative weather observers, are utilized to predict the flood-time discharge of Bear River, a Utah-Wyoming-Idaho stream whose watershed covers 2,900 square miles. From precipitation data available at the end of January a prediction can be made, according to the author, as to whether the flood period of March-July will be high or low as compared with the average; at the end of February a verification or modification of the January prediction can be made; at the end of March an approximation of the quantity of the run-off in day second-feet may be ventured; and at the end of April a quantity estimate can be given which will no doubt closely approach the actual flood-period run-off. From a developed relation of flood and nonflood period run-off, it is also claimed to be possible to predict in advance the run-off during the non-flood period. Only quantity forecasts are attempted, no effort being made to state the form of run-off curve.—J. C. A.

From the importance which Bear Lake, Utah-Idaho storage has in the successful operating of the generating system of the Utah Power and Light Company, comes the desire to successfully predict as far in advance as possible the probable run-off susceptible to storage.<sup>1</sup> On account of the size of the drainage area, about 2,900 square miles, and the inaccessibility of the greater part of it, which includes mountain regions from 8,000 to 10,000 feet in elevation, the ordinary methods of determining probable run-off by intensive snow surveys can not be attempted.

Several years ago studies were begun by the author to determine whether the data obtained by the existing cooperative stations of the United States Weather Bureau could be used in forecasting probable run-off. The belief was entertained that while these stations were situated in the valleys, they still might serve as "indicators" of the precipitation which occurs over the whole area. This has been found to be approximately the case; and is due apparently to the fact that the more important winter storms extend over large areas and precipitation occurs over similar elevations and slopes with considerable uniformity.

The precipitation records from three cooperative stations have been used, namely Border and Evanston, Wyo., and Laketown, Utah. Border is located on the Wyoming-Idaho border about 12 miles northeast of the north end of Bear Lake; Evanston is near the Wyoming-Utah border about 60 miles south-southeast of the south end of Bear Lake; and Laketown is about 2 miles south of the south end of the Lake. These are the only weather stations in this general region having continuous records for many years, the length of the shortest record being about 18 years. Fortunately these stations are located rather far apart, are in desirable locations, and have dependable observers who have served almost continuously at each of the stations.

As the normal precipitation at the three stations is not the same, in order to give equal weight to the three records, the amount in inches for the various periods for each station has been converted into percentages of the average for the 18-year period, and the mean of the three percentages has been used as required in the comparisons.

The run-off records available are from the Dingle gaging station from 1903 to 1915 and from the Harer gaging station since 1913. The annual values appear in Table 1. Both stations are situated above the point of diversion into Bear Lake from Bear River. The quantity of water diverted from the main stream above Harer is partly a matter of river stage, and more water is diverted when the bulk of the run-off occurs in June rather than when it occurs earlier in the season. This statement, it is believed, explains the somewhat erratic plotting of a part of the Dingle points on the comparison diagrams.

On figure 2 four comparisons of precipitation and run-off are made. These consist of four calendar arrangements of the precipitation, namely, November-January; November-February; November-March; and November-April, each of which is compared with the March-July or flood run-off measured at Dingle and Harer.

<sup>1</sup> Alter, J. Cecil: The weather and daily stream flow for hydroelectric plants. Mo. WEATHER REV., May, 1919, 47: 307-309.

The purpose of the four arrangements is to furnish as early as possible each season as much of a prediction regarding probable run-off as might be ventured. From the relations shown in the comparisons it is possible, as

In figure 3 the August-February or nonflood run-off of Bear River for the years 1903-1919 has been plotted against the previous March-July or flood period run-off. From the relation found to exist between the run-off

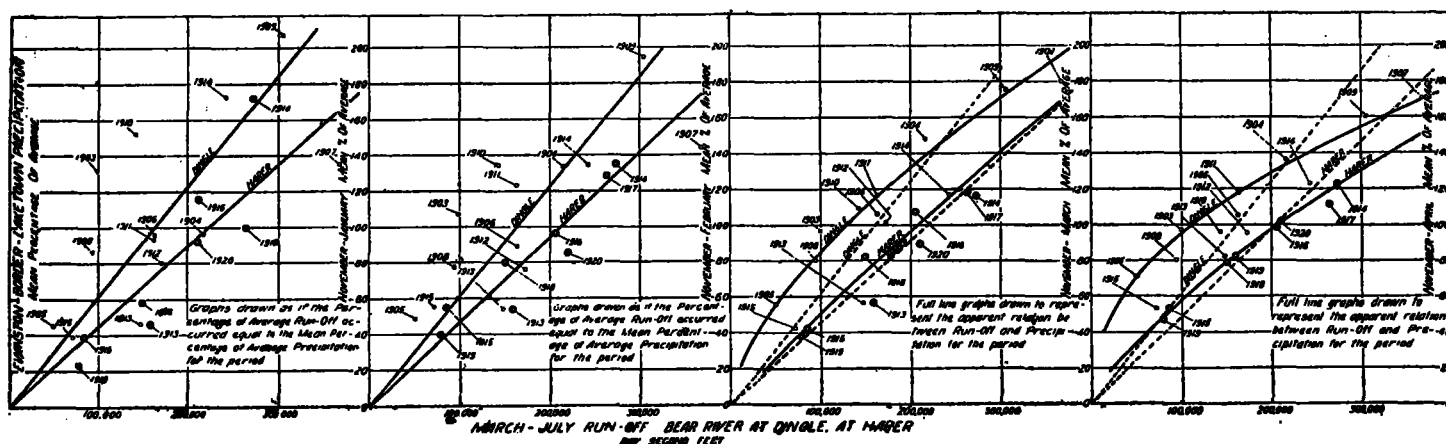


FIG. 2.—Comparisons of precipitation and run-off.

the precipitation records are received from month to month, to venture the following predictions with the positive assurance that the actual run-off performance will bear them out:

At the end of January a prediction as to whether the run-off for the coming flood period will be low, average, or high as compared with other years; at the end of February a verification or modification of the end of January prediction; at the end of March an approximation of the quantity of run-off in day second-feet may be ventured; and at the end of April a quantitative estimate can be given which will no doubt be closely approached by the actual run-off.

This last estimate can be given when the storage period is less than half elapsed. It should be noted that the comparisons provide quantity forecasts only. The rate and time of occurrence are not attempted, as an inspection of the existing run-off records reveals the fact that the form of the flood run-off curves for different years bear little relation to one another.

The straight line graphs on each of the four parts of figure 2 have been drawn as if the percentage of average run-off, March-July, were comparable with the average precipitation, expressed in percentages, for each of the periods shown. This assumption was used for the November-January and the November-February periods simply to show that the tendency of the points was to fall along some such line. The points plotted so scattering for these dates, as a matter of fact, that it was impossible to develop the apparent relation between run-off and precipitation at these times. This assumed relation was continued through the other two periods to show the difference between such assumption and the apparent relation developed by the curves drawn. These curves are apparently the curves of best fit.

**Relation between flood and nonflood period run-off.**—It being apparent that there is little relation between the precipitation during the summer and the run-off during the corresponding months, the curves shown on Diagram No. 2 have been prepared comparing the run-off for the March-July and the August-February periods. This is essential for the purpose of also determining in advance of its occurrence the available energy of the generating system during the nonflood period.

periods as expressed by the curves, it would seem apparent that the variation of the run-off of one year with another is practically dependent upon the amount of precipitation during the previous winter period, con-

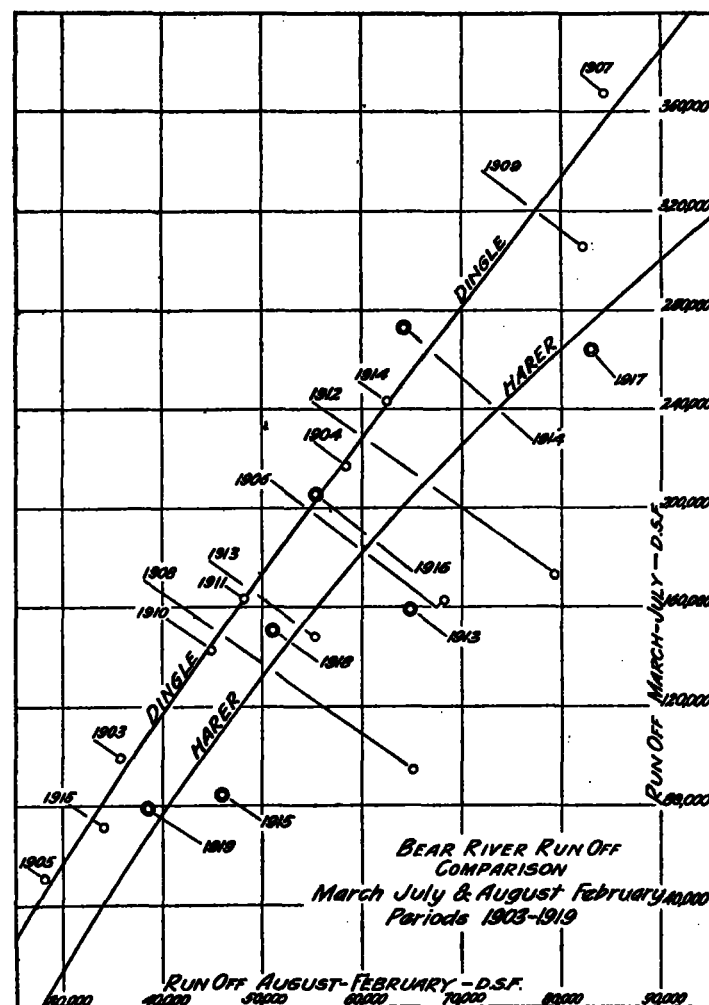


FIG. 3.—Nonflood run-off of Bear River, 1903-1919 compared with preceding flood period run-off.

sidered as November–April; and that the precipitation which occurs outside that winter period, unless abnormal, has relatively little effect in varying the run-off. In other words, it would seem that the winter snows afford the main supply from which the entire year's run-off occurs. Table No. 2 (not reproduced) gives the data shown on Diagram No. 2.

The purpose as stated above for attempting to show the relation expressed by the curves on the diagrams is to permit estimating probable water supply as far in

advance as possible. During the period August–February the flow of Bear River is relatively steady and not subject to great range in stage. Hydrographs show much less variation in form during this nonflood period than occur during the flood period. Such being the case, it should be possible to fairly accurately estimate in advance the monthly run-off during the nonflood period by using the form shown by the hydrographs of previous years, being guided as to total quantity by the relation shown in the diagrams.

## NOTES, ABSTRACTS, AND REVIEWS.

### RESIGNATION OF DR. C. F. BROOKS.

Charles F. Brooks, Meteorologist, United States Weather Bureau and Editor of the MONTHLY WEATHER REVIEW, resigned on June 30, 1921, to accept a newly created associate professorship in meteorology and climatology at Clark University, Worcester, Mass. He writes as follows concerning his new work:

Dr. Wallace W. Atwood, the new president of Clark University, is developing a graduate school of geography. He fittingly recognizes that one of the first requisites in any well-rounded system of instruction in geography is a study of climates, for the atmospheric conditions control to a large extent both the agricultural products and the living habits of man. President Atwood also appreciates that climatology can not be taught adequately without the physical aspects of meteorology. Thus, beginning in the Summer School of 1921, elementary and advanced courses and opportunities for research in both meteorology and climatology are offered. The titles of those to be given in the winter semester are: Meteorology, The Passing Weather, Climatology, Climates of the World, Climatic Environments of the White Race. A fairly complete weather-observing station is being established, primarily for purposes of instruction.

The plan of Clark University includes research as well as teaching. For example, each member of the staff of the School of Geography is expected to spend several months every two years in travel. The results of each expedition are to be published within a year after the return.

The United States Weather Bureau has been most helpful in various ways, especially in providing publications for the university library.

This addition to the all-too-few institutions offering graduate instruction in Meteorology and Climatology is welcomed by the Weather Bureau as providing another source from which its scientific personnel can be recruited.—A. J. H.

### THE AURORA OF MAY 14-15, 1921.

A brief summary of this brilliant and noteworthy aurora will be presented in the next issue (June) of the REVIEW. Sufficient data were not available in time to include the account in this REVIEW.—A. J. H.

### FATHER FROC, S. J., HONORED BY FRANCE.

From *Nature*, London (May 5, 1921, p. 308), we learn that the French Government has awarded the Cross of the Legion of Honor to Father Froc, S. J., who for more than a quarter of a century has been connected with the meteorological work at Zi-ka-wei Observatory. It was at the Jesuit observatory in Manila that Father Faura in 1879 for the first time predicted the existence, dura-

tion, and course of a typhoon in the Far East, and the work at both Manila and Zi-ka-wei has been of the greatest importance to those who sail the China seas. Zi-ka-wei, which stands about 4 miles from the international settlement of Shanghai, derives its name from a distinguished Chinese who was converted to the Christian faith by Matthew Ricci 300 years ago, and whose grave lies close to the observatory. Besides the observatory the Jesuit mission has here a fine cathedral, a college, an orphanage, a convent, and a natural history museum. The work of Father Froc and of his colleagues, Fathers Chevalier and Gauthier, has the support of the community at Shanghai, and the observatory at Zi-ka-wei and those at Zose and Liu-ka-pong connected with it are an object lesson to the Chinese Government.

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### ORIGIN OF THE SOUTHWEST MONSOON.<sup>1</sup>

By G. C. SIMPSON.

[Reprinted from *Nature*, London, Mar. 31, 1921, p. 154.]

It has generally been held that the southwest monsoon owes its origin to the great difference of temperature which exists during the summer months between the heated land surface of India and the surrounding oceans, the general idea being that the warm air over the land rises, and damp air from the sea flows into India to take its place, thus resulting in the strong southwest winds, the rainfall itself being due to the cooling of the air as it rises over India.

This theory has to face the difficulties that the temperature over India is much higher in May, before the monsoon sets in, than it is during the monsoon itself; that the temperature is higher in years of bad monsoon than in years of good monsoon; and that the part of India which has the highest temperature and the lowest pressure, and where ascending currents should be the greatest, is a region of practically no rainfall throughout the monsoon.

The true explanation of the southwest monsoon can be obtained only by taking a wide view of the weather conditions over large parts of the earth's surface during the summer months in the Northern Hemisphere. It is then seen that the southwest winds are not due to the temperature in India, but are a relatively small part of a general circulation of the atmosphere caused by a region of high pressure over the South Indian Ocean and a region

<sup>1</sup> Abstract of a paper entitled "The Southwest Monsoon," read to the Royal Meteorological Society on Wednesday, March 16